KerrisdaleCapital

October 22, 2014

Via Electronic Filing

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Re: Written Ex Parte Communication
***Terrestrial Use of the 2473-2495 MHz Band for Low-Power Mobile Broadband Networks; Amendments to Rules for the Ancillary Terrestrial Component of Mobile Satellite Service Systems,* IB Docket No. 13-213, RM-11685**

Dear Ms. Dortch:

Kerrisdale Capital Management, LLC (Kerrisdale) respectfully submits this *ex parte* letter in the above-referenced dockets in order to provide real-world testing data regarding Globalstar, Inc. (Globalstar)'s planned Terrestrial Low Power Service (TLPS).[1] As Kerrisdale stated in its *ex parte* letter to the Federal Communications Commission (FCC) dated October 10, 2014, the test results presented by Globalstar and its technical partner, Jarvinian Wireless Innovation Fund (Jarvinian), are inadequate and misleading. Globalstar has characterized its "initial tests" as confirming that TLPS "surpass[es] public Wi-Fi by 5x the effective distance and 4x the effective capacity," and that TLPS will have "no impact on public Wi-Fi operations in adjacent channels."[2] However, lab tests conducted by an independent, Wi-Fi CERTIFIED[3] testing laboratory, Allion Engineering Services (Allion), show that Globalstar's TLPS (if deployed) could reduce the capacity of nearby unlicensed networks by as much as 60 or 70 percent. Moreover, engineering simulations also call into question the actual range of Globalstar's TLPS. Kerrisdale respectfully requests that the FCC consider these tests as it assesses Globalstar's request to leverage its licensed spectrum with unlicensed, publicly available spectrum in the 2.4 GHz Band.

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[1] *See* Letter from Sahm Adrangi, Kerrisdale Capital Management, LLC, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 13-213, RM-11685 (filed Oct. 10, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=60000972585 (Kerrisdale *Ex Parte*).

[2] *See, e.g.*, Letter from L. Barbee Ponder IV, General Counsel and Vice President Regulatory Affairs, Globalstar, Inc., to Mignon Clyburn, Chairwoman, FCC, RM-11685, at 1 (dated June 10, 2013 Letter), *available at* http://apps.fcc.gov/ecfs/document/view?id=7022424140.

[3] The Wi-Fi CERTIFIED™ program includes a number of independent laboratories that "assure[] tested and proven interoperability among Wi-Fi® devices." *See* Wi-Fi Alliance®, Certification, Authorized Test Laboratories, http://www.wi-fi.org/certification/authorized-test-laboratories (last visited Oct. 21, 2014).

Globalstar's Tests Overstate the Actual Range of a TLPS Access Point

As the FCC is aware, Globalstar and Jarvinian have included in the record only a few documents to evidence the potential performance of TLPS. Kerrisdale previously questioned whether these "test results" were merely simulations, or "predictive surveys," rather than real tests. Among other grounds for skepticism, Globalstar failed to provide any information about what user devices were involved in the tests and what tools it relied on to measure throughput. Real-world tests typically make explicit the key operational details of the test bed, which ensures that the test results can be replicated.[4] Moreover, based on the judgment of multiple Wi-Fi practitioners with whom we consulted, the purported coverage provided by Jarvinian's single access point (AP) looked unrealistically wide given the effects of attenuation sources like interior walls. Additionally, based on our review of the relevant timeline, Jarvinian did not have an experimental license to use the equipment it purported to use at the time it claimed to conduct its tests.

Kerrisdale elected to independently assess Globalstar's assertions that the proposed TLPS operations would surpass public Wi-Fi in both effective distance and effective capacity. In order to do so, we commissioned an engineer to undertake two exercises. First, given the existing floor plan of the office space purportedly tested by Jarvinian,[5] we asked how much coverage a single AP placed in the corner of the space would actually achieve. Second, given the same floor plan, and based on a fairly standard set of design criteria aimed at supporting wireless voice over IP (VoIP) communications, we asked what a realistic Wi-Fi network would actually look like in the same space. The engineering was conducted using the Wi-Fi site survey program Ekahau.[6]

Contrary to Globalstar's apparent assertion that TLPS would be useable through the entire space, the engineering analysis detailed below indicates that the signal strength would fall to an unusably low level throughout the bulk of the space and that much of the AP's high radiated power would be pointlessly wasted on the exterior of the building:

[4] Kerrisdale *Ex Parte* at 6.

[5] The detailed floor plan of the Two Canal Park fifth-floor space in Cambridge can be found at http://f.tlcollect.com/fr2/213/48789/2First_Floorplans_(Low).pdf (*see* pages 5-6).

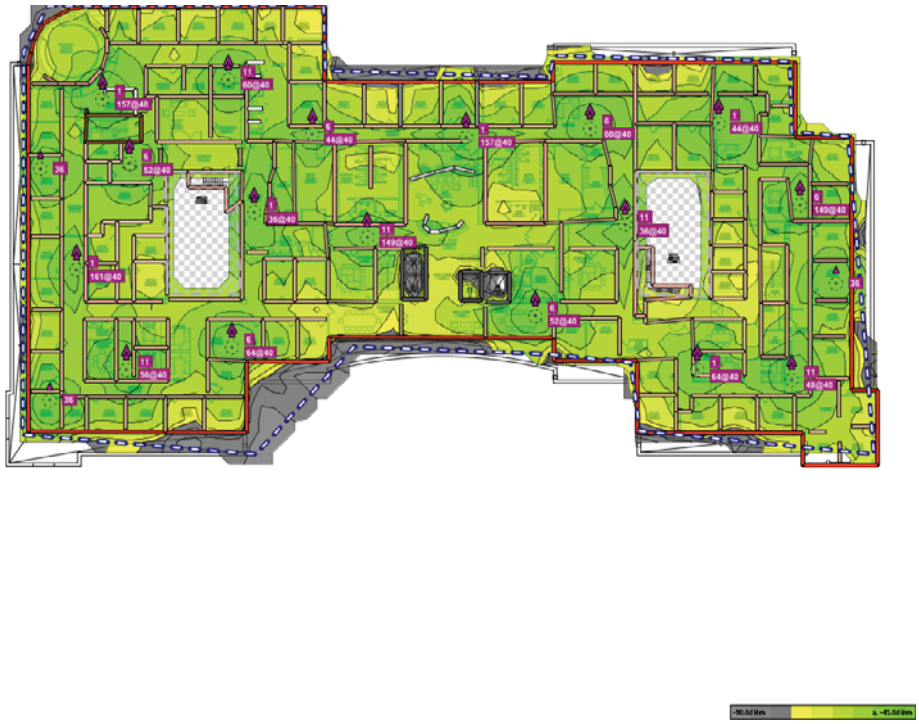
[6] Kerrisdale has made both the underlying data file and the automated summary report publicly available and encourages wireless networking professionals to examine the results. *See* Ekahau Report, Dual-Band VoIP with Walls, http://kerrisdalecap.com/wp-content/uploads/2014/10/Dual-Band-VoIP-With-Walls-Report.pdf (last visited Oct. 21, 2014); Dropbox, 5th Floor Dual-Band VoIP, https://www.dropbox.com/s/hq5jhs093ts241z/5th%20floor%20Dual-Band%20VoIP.esx?dl=0 (last visited Oct. 21, 2014).

Source: Ekahau predictive survey commissioned by Kerrisdale using publicly available Two Canal Park floor plan.
Note: The color represents 2.4 GHz Band signal strength measured in dBm.

The impact of interior walls and other sources of attenuation in the environment drastically cut down the projected range of any 2.4 GHz Band Wi-Fi signal emitted from the location Jarvinian used, with or without TLPS. The resulting weak signal simply would not be heard by many user devices. While adding TLPS access points in the 40,000 square foot environment would eventually produce a uniform enough signal to provide continuous coverage, it would do nothing to increase capacity, since all of these APs would be sharing a single channel.

By contrast, what would a realistic Wi-Fi network in this space look like? The answer depends on what the network needs to do. A lightly used warehouse network might only require a handful of APs, while a densely packed convention center might need many. For the Two Canal Park space, we drew on Cisco's "Voice over WLAN Radio Frequency Design,"[7] a standard point of reference for many Wi-Fi professionals. Key design criteria include a minimum signal strength of -67 dBm, a minimum signal-to-noise ratio of 25 dB, and enough overlap between APs to assure smooth roaming through the space. The diagram below illustrates the resulting design, a hand-optimized revision of what the Ekahau software itself automatically suggests:

[7] *See* Cisco, Voice over WLAN Radio Frequency Design, http://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Mobility/vowlan/41dg/vowlan41dg-book/vowlan_ch3.html (last visited Oct. 21, 2014).



Source: Ekahau predictive survey commissioned by Kerrisdale using publicly available Two Canal Park floor plan.
Note: The color represents 5 GHz Band signal strength measured in dBm.

The design includes 20 APs, of which 17 are dual-band (including both 2.4 GHz Band and 5 GHz Band radios) and three are single-band (5 GHz Band only – either dual-band APs with the 2.4 GHz Band radios deactivated or a device like the Ruckus ZoneFlex 7321 set to operate on the 5 GHz Band). In the 5 GHz Band, the design exploits the greater available bandwidth and uses 40-megahertz channels – 10 in total – in addition to the three channels used in the 2.4 GHz Band. According to Ekahau's analytics, these APs could support 100 laptops, 50 tablets, and 50 VoIP-enabled smartphones.

To be sure, the above depicted design is not the one, true answer for how to configure a Wi-Fi network in the available space. For some purposes, it might be overkill; for others, it might not be enough. However, a professional designer would not attempt to support hundreds of devices without making extensive use of the 5 GHz Band, in some cases even disabling 2.4 GHz Band radios. Given the vast selection of 5 GHz Band channels, Wi-Fi congestion would be at best a minor concern here, since the 5 GHz Band would provide the bulk of the potential throughput.

Lab Tests Show the Harmful Impact of TLPS on Public Wi-Fi Operations

As previously noted, Globalstar has maintained that TLPS will not affect the performance of existing Wi-Fi systems using the unlicensed spectrum bands and, indeed, that the FCC need not consider the harmful interference to these services at all.[8] Other parties, however, have questioned this assertion and called for Globalstar to present additional testing to support its claim that unlicensed operations will not suffer from harmful interference if TLPS is deployed.[9] In order to inform the record in this proceeding, we commissioned testing from Allion to assess the potential interference inflicted by TLPS on unlicensed Wi-Fi operations.[10] Assuming for the sake of argument that TLPS can and will be deployed, the results of these tests demonstrate that there is every reason to expect TLPS would harm nearby Wi-Fi networks operating on Channel 11 in the 2.4 GHz Band. Indeed, the single-channel nature of TLPS would be unusually detrimental to unlicensed Wi-Fi. As Globalstar conceives it, TLPS would be a single-channel service that would never budge from Channel 14. As a result, TLPS APs, if any were ever deployed on a meaningful scale, would be worse "neighbors" than APs using conventional Wi-Fi.

Allion conducted a series of experiments assessing the impact of Channel 14 Wi-Fi activity on unlicensed Channel 11 operations. Since Channel 14 cannot be legally used under ordinary conditions, the tests were conducted inside an anechoic chamber, which prevented outside signals from entering and inside signals from escaping. First, Allion measured the baseline throughput of a single AP (either a NETGEAR R7000 or a Cisco Aironet 1262) connecting to a single client device (a MacBook Pro) at

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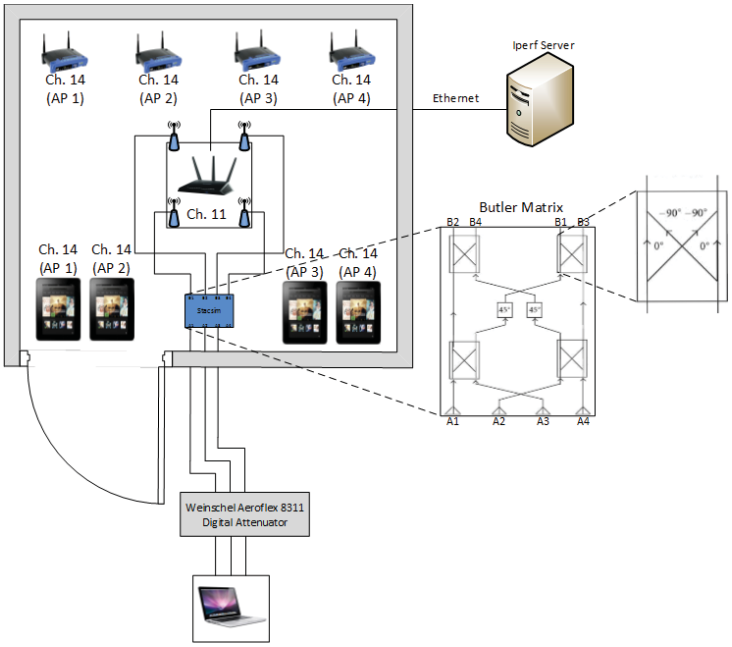
[8] *See, e.g.*, Comments of Globalstar, Inc., IB 13-213, RM-11685, at 29-32 (filed May 5, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521112687 (arguing that the proposed TLPS will coexist successfully with unlicensed operations in the 2.4 GHz Band); Reply Comments of Globalstar, Inc., IB 13-213, RM-11685, at 13-18 (filed June 4, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521274411 (asserting that Globalstar need not submit additional test data demonstrating that there will be no detrimental impact on unlicensed services).

[9] *See, e.g.*, Comments of the National Cable and Telecommunications Association, IB Docket No. 13-213, RM-11685, at 16-18 (filed May 5, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521116269 (urging the FCC to require Globalstar to demonstrate that it will not cause an unacceptable amount of harmful interference to unlicensed users); Comments of Wi-Fi Alliance, IB 13-213, RM-11685, at 6-10 (filed May 5, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521111476 (stating that Globalstar's proposal may negatively affect the operating environment for existing Wi-Fi and other unlicensed operations and calling on the FCC to require Globalstar to demonstrate that its proposed operations can co-exist with operations in the 2.4 GHz Band); Comments of the Wireless Internet Service Providers Association, IB 13-213, RM-11685, at 3-5 (filed May 5, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521109447 (arguing that Globalstar must engage in meaningful field testing to determine whether its proposed operations would cause harmful interference to devices operating in the 2.4 GHz Band); Reply Comments of Wi-Fi Alliance, IB Docket No. 13-213, RM-11685, at 19-20 (filed June 4, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521271330 (stating that Globalstar was incorrect when it stated that it has no obligation to protect unlicensed operations); Reply Comments of the Wireless Internet Service Providers Association, IB 13-213, RM-11685, at 3-7 (filed June 4, 2014), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521203778 (stating that Globalstar failed to acknowledge its obligation to consider the interference impact on unlicensed devices already operating in the 2.4 GHz Band).

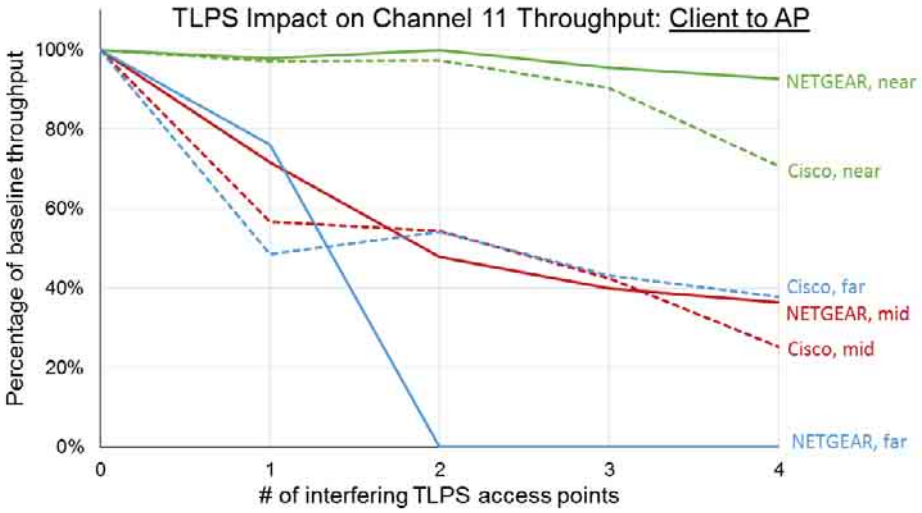
[10] The Allion Report is attached hereto as Attachment A.

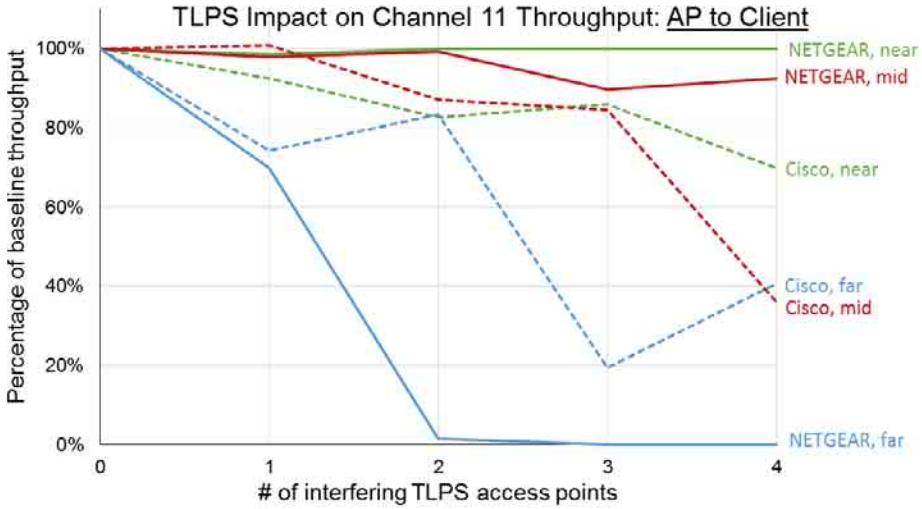
different levels of signal strength. Then, Allion added to the chamber a Channel 14 AP (the Linksys WRT54GL) connecting to a single client device (a Kindle Fire tablet) and re-measured the throughput on Channel 14. The Channel 14 signal was attenuated (using shielding fabric) in order to achieve a "nearby" but not unrealistically high signal strength of -60 to -70 dBm. Next, the testers added a second, third, and fourth Channel 14 AP and re-measured the Channel 11 throughput. The setup appeared as follows:



Source: Allion Report at 4.
Note: The devices shown on the top row within the chamber are Linksys APs on Channel 14. The devices shown on the bottom row within the chamber are Kindle Fire tablets connecting to those Channel 14 APs. The Channel 11 AP shown in the center is a NETGEAR R7000. The Iperf server shown on the right generates network traffic in order to measure throughput. The Butler matrix diagrammed on the right simulates multipath effects critical to achieving higher realized throughputs with multiple spatial streams. The digital attenuator manually reduces signal strength from the Channel 11 AP to the Channel 11 client (the MacBook Pro shown at the bottom of the diagram) at the testers' discretion in order to simulate different AP-to-client distances within a relatively compact chamber.

The results of Allion's real-world experiments rebut Globalstar's assertions that TLPS – if deployed – would not impact public Wi-Fi operations. With an extremely strong connection, Channel 11 devices were sometimes unaffected by nearby Channel 14 activity. However, in almost every other case, across both AP models tested, realistic levels of Channel 14 activity resulted in declines in Channel 11 throughput. For a Channel 11 client connected at a signal strength of -55 to -60 dBm, nearby TLPS APs cut throughput in half or worse. For a Channel 11 client connected near the "cell edge" with a relatively low but still usable signal strength of -75 to -80 dBm, throughput declined from ~10 Mbps to zero with the introduction of only a handful of TLPS access points. In other words, the presence of nearby TLPS activity could make or break an unrelated Wi-Fi connection. While further testing may provide additional data on the precise nature of TLPS interference, these initial tests, conducted by a reputable and independent lab, confirm what many commenters have said: usage of Channel 14 would indeed result in interference to Channel 11.





Source: Kerrisdale analysis of data provided by Allion Engineering Services.
Note: "Near"/"mid"/"far" represent 20/40/60 dB of Channel 11 attenuation, respectively. Solid lines represent NETGEAR results; dashed lines represent Cisco. Absolute throughput figures are not comparable between the two APs because the NETGEAR model is three-stream, while the Cisco model is two-stream.

Conclusion

Although Globalstar maintains that its TLPS network will surpass Wi-Fi in both distance and capacity, without causing harmful interference to the millions of devices using neighboring unlicensed spectrum, testing demonstrates that neither claim is sustainable. For one thing, the simulated tests conducted by Globalstar and Jarvinian are highly misleading: independent simulations demonstrate that TLPS will never be able to match the throughput and capacity of a competently designed network utilizing the many available 5 GHz Band channels available today for free. More importantly, real-world testing commissioned from a reputable, independent laboratory demonstrates that activity on Channel 14 would in fact reduce throughput on Channel 11, sometimes dramatically, disproving yet another of Globalstar's claims. Kerrisdale appreciates the opportunity to submit the results of these simulations and tests into the record and welcomes substantive critiques of both our analysis of Globalstar's tests and the lab results exploring the interference potential of TLPS.

Pursuant to Section 1.1206(b)(2) of the Commission's rules, an electronic copy of this letter is being filed for inclusion in the above-referenced dockets. Please direct any questions regarding this filing to the undersigned.

Respectfully submitted,

/s/ Sahm Adrangi

KERRISDALE CAPITAL MANAGEMENT, LLC

Attachment

cc: (via email)
Renee Gregory, Office of Chairman Tom Wheeler
Louis Peraertz, Office of Commissioner Mignon Clyburn
David Goldman, Office of Commissioner Jessica Rosenworcel
Brendan Carr, Office of Commissioner Ajit Pai
Erin McGrath, Office of Commissioner Michael O'Rielly
Mindel De La Torre, Chief, International Bureau
Roger Sherman, Chief, Wireless Telecommunications Bureau
Julius Knapp, Chief, Office of Engineering and Technology

Attachment A

ALLIQN® USA
ENGINEERING SERVICES

Kerrisdale Capital: Wi-Fi Adjacent Channel Interference

10/14/2014

Overview

Testing the impact of operations using Channel 14 on neighboring networks in Channel 11 (tested inside anechoic chamber)

1. Baseline performance of Ch. 11 (20MHz) with a single client and AP
    - Macbook Pro (3x3 802.11ac model)
    - Test with residential grade AP (NETGEAR R7000)
    - Repeat with enterprise grade AP (Cisco 1262)
2. Introduce interference on Ch. 14
    - Additional client(s) and AP(s) will be placed in the same room running iperf traffic
    - Interference will gradually be increased by adding more APs and clients on Ch. 14 (up to four)
    - Interference APs are to be attenuated out to simulate “nearby” neighboring APs (targeting -60 to -70dBm of RSSI)
    - Measure throughput on Ch. 11

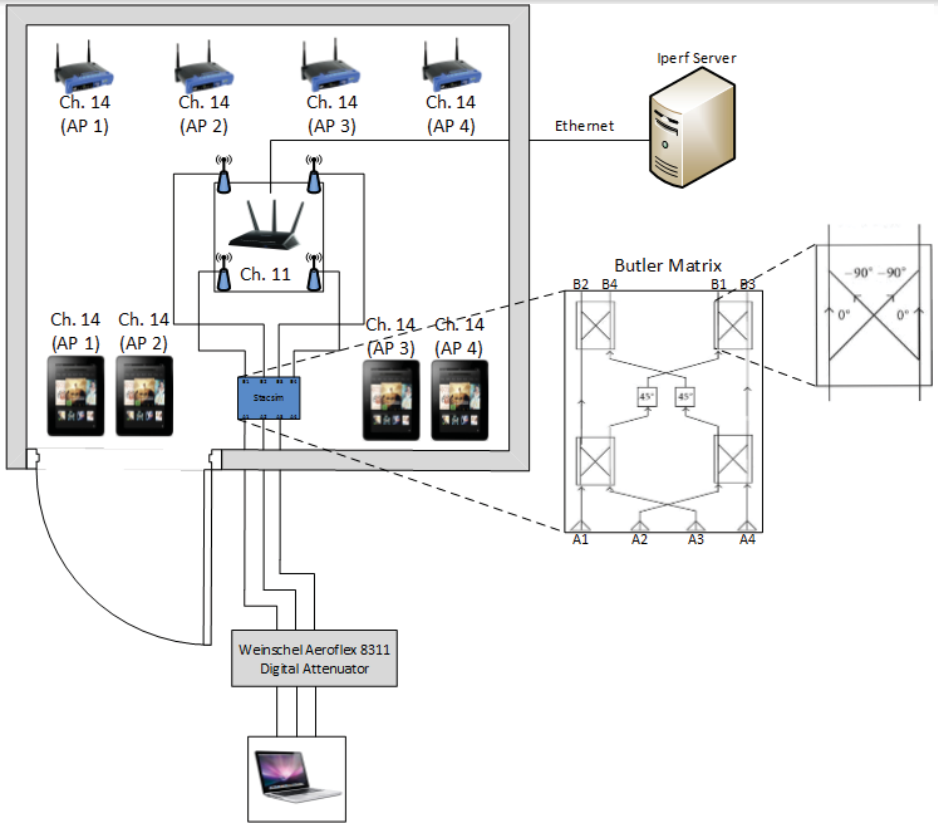
AP / Client Overview

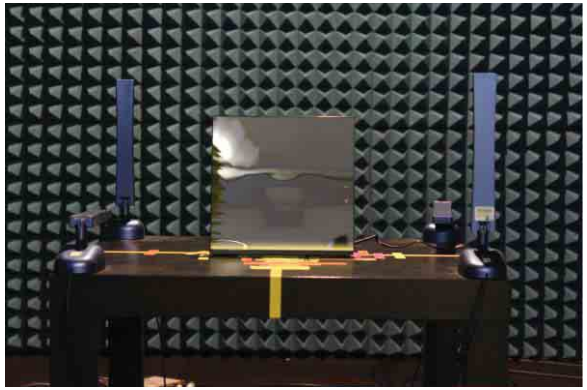
AP Used			
Vendor	NETGEAR	Cisco	Linksys
Model	R7000	1262	WRT54GL
FW Version	V.1.0.3.68_1.1.31	12.4(25d)JA1	Tomato v 1.28



Station System	
Vendor	Apple
Model	Mac Book Pro 13” (802.11a/b/g/n/ac)
FW Version	10.9.2 (13C64)

Testing Methodology: Hybrid OTA + Conductive (Anechoic Chamber)

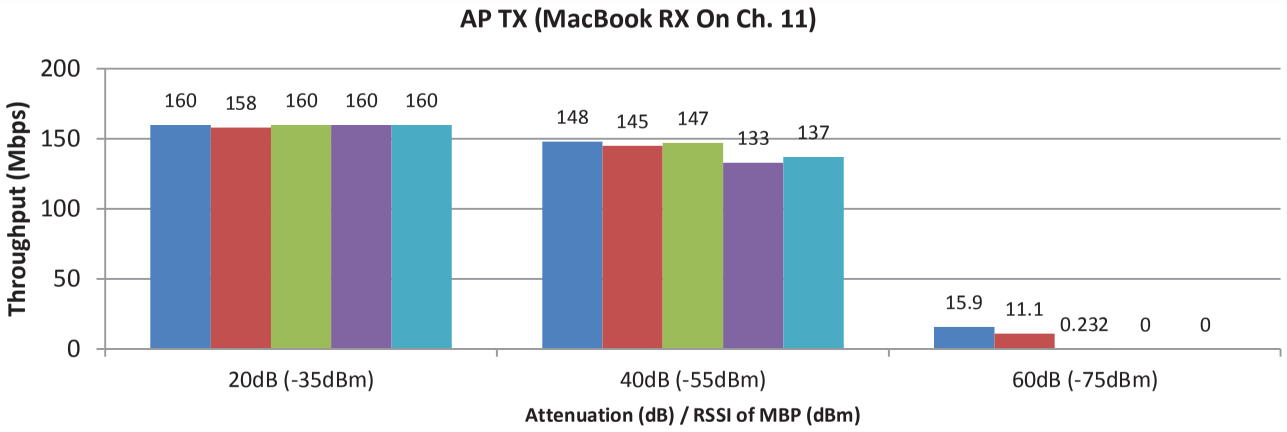


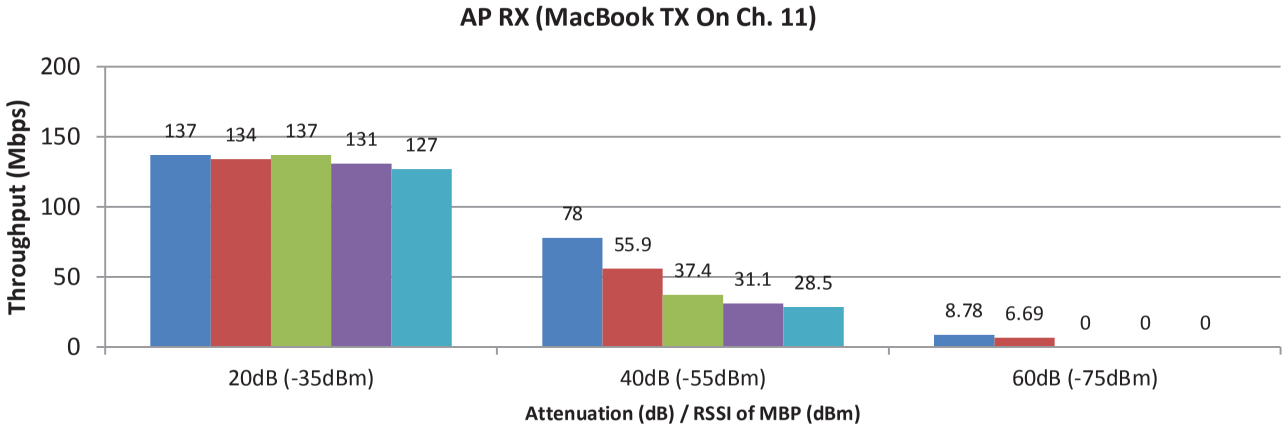


Note:

- 1 client was associated per interfering AP
- MacBook Iperf flags: iperf –c <ip> -w 256K –l 1460 –fm –i1 –P4 –t30
- Tablet Iperf flags: iperf –c <ip> -w 256K –l 1460 –fm –i1 -r –t30

NETGEAR R7000





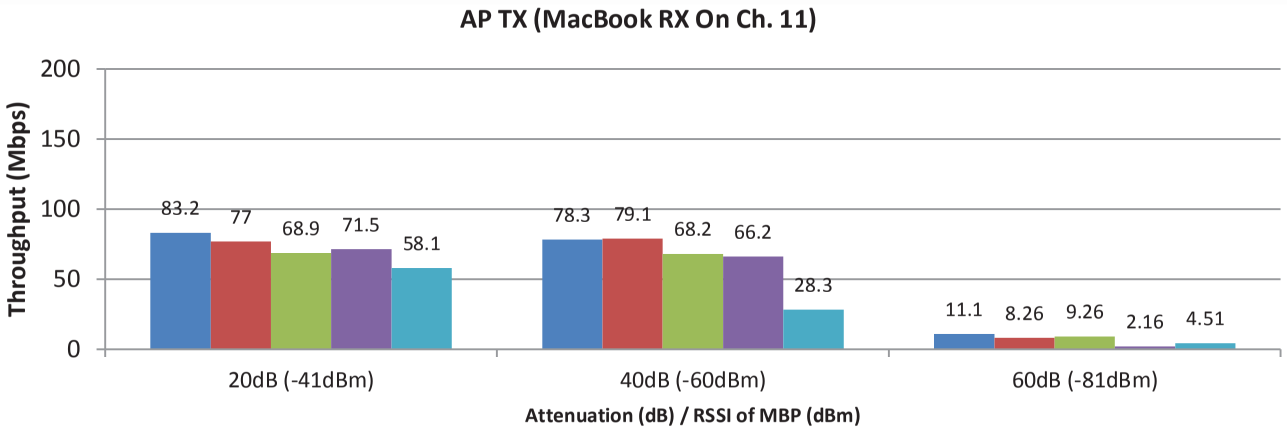
Overview:

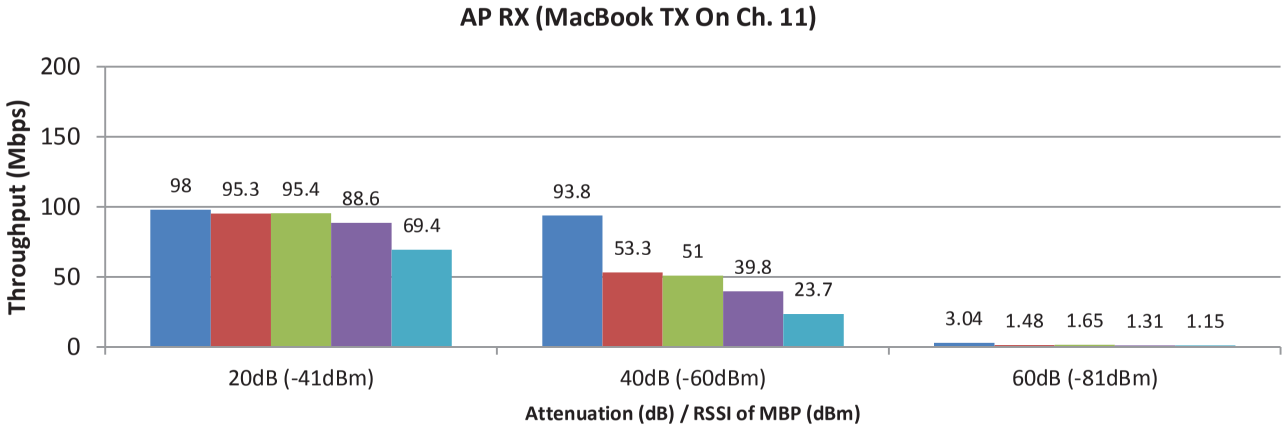
- NETGEAR R7000 Settings:
  - Channel: 11 (HT-20)
  - 802.11 Mode: 802.11n
- Linksys WRT54GL:
  - Channel: 14
  - 802.11 Mode: 802.11b

Observations:

- AP RX saw the largest impact with channel 14 interference
- MacBook was no longer able to pass traffic at 60dB when more than two Ch. 14 clients were running

Cisco 1262





Overview:

- Cisco 1262 Settings:
  - Channel: 11 (HT-20)
  - 802.11 Mode: 802.11n
- Linksys WRT54GL:
  - Channel: 14
  - 802.11 Mode: 802.11b

Observations:

- AP RX saw the largest impact with channel 14 interference

Thank you!